Appendix A

Site Review
Travel Report

BUREAU OF RECLAMATION
Technical Service Center

TRAVEL REPORT

PRJ-8.10
D-8120

Codes : D-8120/D-8130/D-8140/D-8312/D-8320 Date: December 9, 2003

To : Thomas C. Fisher
Manager, Structural and Architectural Group

From : Dick LaFond, D-8120, Structural Engineer and TSC Engineering Team Leader
Doug Stanton, Civil Engineer, D-8130
Dave Edwards, Civil Engineer, D-8140
Bill Engemoen, Geotechnical Engineer, D-8312
Pete Rohrer, Geologist, D-8320

Subject: Technical Site Review of Proposed Black Rock Project Sites, Yakima River Basin Water Storage Options, Feasibility Study, Washington

1. Travel period: October 27-30, 2003.

2. Places or offices visited: Priest Rapids Dam, Proposed Black Rock Reservoir Site, Roza Canal, and Pacific Northwest Construction Office, Yakima, WA.

3. Purpose of trip: To view proposed sites for features associated with the Black Rock Storage Project and to discuss ongoing and future work with representatives from the Pacific Northwest Region, Upper Columbia Area, and Pacific Northwest Construction Offices.

4. Synopsis of trip:

A. Site Review Kickoff Meeting- On the morning of October 28, 2003, we met with representatives from the Pacific Northwest Region Office, Upper Columbia Area Office, Pacific Northwest Construction Office, Yakama Nation Water Resources, and Washington Department of the Ecology to discuss work to date, ongoing work, and plans for the site review. A list of attendees and major discussion items is included as attachment 1.

B. Site Visit to Proposed Black Rock Project Features - On October 28 and 29, 2003, we visited the proposed sites for the Columbia River Pumping Plant, Black Rock Reservoir and Roza Canal Outlet Structure. A list of major observations and discussions is included as attachment 2.

C. Site Review Closeout Meeting - On the morning of October 30, 2003, we met with representatives from the Pacific Northwest Region Office, Upper Columbia Area Office, Pacific Northwest Construction Office, Yakama Nation Water Resources, and Washington Department of the Ecology to discuss general observations from the site review and future work. A list of attendees and major discussion items is included as attachment 3.

5. Conclusions: The trip provided an opportunity to obtain a clearer understanding the of scope of TSC work. See attachments for other conclusions.

6. Action correspondence initiated: None. See attachments for action items.

7. Client feedback: The Technical Service Center site investigation team would like to thank Dick Link of the Pacific Northwest Region Office for coordinating the site review.

Attachments

cc: Regional Director, Boise, ID
Attention: PN-3400 (Jennings), PN-3440 (Montague), PN-3600 (Link)
Manager, Upper Columbia Area Office, Yakima, WA
Attention: UCAO-1000 (Glover), UCAO-1100 (Ries)
Project Construction Engineer, Yakima, WA
Attention: NCO-3100 (Meskimen), NCO-3110 (Manfredi), NCO-3173 (Christensen)
Manager, Grand Coulee Power Office, Grand Coulee, WA
Attention: GCP-5500 (Didricksen)
(w/all attachments to each)

bc: D-8120 (LaFond), D-8130 (Stanton), D-8140 (Edwards), D-8160 (Donat), D-8170 (Donaldson), D-8312 (Engemoen), D-8320 (Rohrer), D-8410 (Christensen), D-8420 (Zelenka), D-8430 (Rossi), D-8440 (Gamuciello), D-8580 (Quinn), D-8580 (Holz)
(w/all attachments to each)

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SIGNATURES AND SURNAMES FOR:

Travel to: Priest Rapids Dam, Proposed Black Rock Reservoir Site, Roza Canal, and Pacific Northwest Construction Office, Yakima, WA.

Dates of Travel: October 27-30, 2003

Names and Codes of Travelers:

Traveler	Date
Doug Stanton, D-8130	12-11-03
Dave Edwards, D-8140	12/11/03
Bill Engemoen, D-8312	12/11/03
Pete Rohrer, D-8320	
Dick LaFond, D-8120	12/10/03

Noted and Dated By:

10/11/03

Attachment 1

Black Rock Storage Project

Site Review Kickoff Meeting
October 28, 2003

PARTICIPANTS:

NAME	COMPANY
Dick Link	Pacific Northwest Region Office
Kayti Didricksen	Pacific Northwest Region Office
Don Stelma	Pacific Northwest Region Office
John Kirk	State of Washington - Department of Ecology
David Cummings	State of Washington - Department of Ecology
Tom Ring	Yakama Nation - Water Resources
Norbert Ries	Upper Columbia Area Office
Mark DeLeon	Upper Columbia Area Office
Bernie Meskimen	Pacific Northwest Construction Office
Wendy Christensen	Pacific Northwest Construction Office
Charles Ferguson	Pacific Northwest Construction Office
Erin Quinn	Technical Service Center
Doug Stanton	Technical Service Center
Dave Edwards	Technical Service Center
Bill Engemoen	Technical Service Center
Pete Rohrer	Technical Service Center
Dick LaFond	Technical Service Center

MAJOR DISCUSSION TOPICS: The following items were discussed:

1. Norbert Ries stated that the Black Rock Storage Project is one option to be considered during the Yakima River Basin Water Storage Feasibility Study. Legislation authorizing this study requests Reclamation to conduct a feasibility study of options for additional water storage in the Yakima River Basin with emphasis on the feasibility of storing Columbia River water in the proposed offstream Black Rock Reservoir.

a. The objective of the Black Rock Storage Project is to deliver Columbia River water to Yakima Project entities susceptible to receiving such water and willing to exchange it for all or part of their current Yakima River diversions. No new irrigation will result from this exchange and no Columbia River water will be discharged directly into the Yakima River.

b. The present focus is to conduct an appraisal level assessment of likely configurations and sizes of Black Rock Project facilities to pump, store, and deliver water to willing exchange participants. Currently, these consist of the Roza and Sunnyside Divisions who have expressed a willingness to consider water exchanges. It may also be possible to exchange water with other entities such as the Union Gap Irrigation District and the Selah-Moxee Irrigation District. The Washington Infrastructure Services (WIS) Final Report dated May 2002, was a reconnaissance level analysis to identify and compare multiple options to transfer water from the Columbia River to the Yakima Basin. Costs developed for the WIS study were used to compare the identified options against each other and develop an order-of-magnitude estimate of project costs but detailed design/cost analyses of any one option were not completed. Reclamation's Assessment Study should use information in the WIS Report and data obtained since the report was completed to develop one or two options in greater detail to permit a better definition of required features, understanding of obstacles, and development of more accurate construction costs. The Assessment Study Findings will be documented in a report prepared by Reclamation that is tentatively due by June 30, 2004.

2. Don Stelma reported on the findings of the geologic investigations that were completed by WIS after their May 2002 Final Report. Field investigations were located along the preferred dam alignment identified by WIS. These geologic investigations are documented in the Black Rock Reservoir Study -Initial Geotechnical Investigation - Final Report dated January 2003.

a. Along the present dam alignment, the depth of overburden deposits range from a few feet to 200 feet near the right abutment. WIS cost estimates assumed bedrock would be within 20 feet of the surface.

b. It may be acceptable to not excavate the Ringold Formation and use it as part of an embankment dam foundation, provided that the Ringold proves to be a satisfactory foundation material.

c. There is a thrust fault in the right (south) abutment. The abutment is highly fractured and may be the site of an old rockslide.

d. No recent active faults have been identified to date.

e. The basalt foundation rock has permeable zones. Although the Ringold Formation and interbeds which might be aquitards are present, the areal extent and thickness of these units are not well defined. Creation of an adequate grout curtain might be problematic because there appears to be no water barrier below the dam to tie in a grout curtain that would positively cut off seepage.

f. The Selah Interbed material is composed chiefly of fine-grained silts and clays; reservoir landslides are possible where folding along the Rattlesnake Hills anticline has oversteepened the bedrock sequence. The Selah Interbed represents a potential plane of weakness where sliding could occur under saturated conditions resulting from a Black Rock reservoir.

3. Bedrock is exposed at a draw near Horsethief Point located about 2,500 feet upstream of the preferred WIS alignment. Don said they think there is a cross-valley fault between this location and the preferred WIS alignment and overburden along the new alignment may not be as deep. The PN Region drill crew plans to drill a 400-foot-deep hole along the new alignment to locate top of rock and perform water tests to check permeability.

4. Geologic mapping of the new alignment by Dr. Robert Bentley is ongoing. Dr. Bentley is a consulting geologist and professor emeritus at Central Washington University in Ellensburg, WA. Field work is nearly completed and a draft geologic report is expected on or about December 1, 2003.

5. Dick Link stated that Matt Jones (TSC) is working on the photogrammetry. Several files received from the contractor are corrupt and Matt has requested corrected data. To date, reservoir storage calculations have been developed from USGS Quad Sheets. Topography developed from the aerial surveys should be available mid-December.

6. Kayti Didricksen discussed existing groundwater information at the proposed reservoir site. She said her studies will address impacts of the reservoir on regional groundwater surfaces.

a. The jointing of the basalt flows permits vertical communication between aquifers. Interflow zones between the basalt flows permit horizontal flow from the site. The horizontal permeability of the basalt is much greater than the vertical permeability.

b. Currently there is very little aquifer recharge at the proposed Black Rock reservoir site but this will change when water storage is initiated.

c. Permeability tests performed by WIS encountered problems (leaky packers) and data developed from this testing tend to overestimate potential reservoir seepage.

d. Kayti is trying to get groundwater data from the Hanford Nuclear Repository Site to help define groundwater flow characteristics in the reservoir area. The gradient at the proposed Black Rock site moves towards Hanford.

7. In summary, Dick Link stated that from a geologic perspective the possible presence of subsurface faults, reservoir seismicity, foundation rock quality, and availability of construction materials are items that could significantly affect the feasibility and cost of constructing a dam and reservoir in the Black Rock Valley.

Attachment 2

Black Rock Storage Project

Technical Site Review
October 28-29, 2003

MAJOR OBSERVATIONS AND DISCUSSIONS:

Priest Rapids Dam and Columbia River Intake Sites

1. The Site Review Team met Leon Hoepner and Dave Moore of the Grant County Public Utility District (PUD) at Priest Rapids Dam and proceeded across the dam to the right abutment to view possible locations for an intake, fish screen, and pumping plant.

2. Leon Hoepner stated that locating a river-side pumping plant more than 4 miles downstream of the dam would place the plant within the Hanford Reach which may not be politically and/or environmentally acceptable.

3. Daily river fluctuations downstream of the dam can be as high as 14 feet but they try to operate to limit fluctuations to 5-6 feet. There is a gauging station located downstream of the dam. Daily reservoir fluctuation is 3-4 feet.

4. Leon stated that a fish biologist for Washington Infrastructure Services (WIS) had visited the dam and recommended moving the intake and fish screen facility to the left side of the dam in a follow-up report.

5. Leon stated that lamprey impingement on passive fish screens could control screen design over salmonid concerns.

6. There appears to be sufficient room between the right reservoir dike and foothills of the Umtanum Ridge to locate a channel intake with diagonal fish screens to supply a pumping plant located at the base of the ridge. The intake would be located directly downstream of the existing Grant County PUD dock facility and hazard boom anchor. A bypass pipe could be run along the groin of the dam to pass screened fish downstream of the dam. The pumping plant could be located slightly downstream of the dam and a tunnel excavated to cross under the ridge instead of piping up and over it. Topography, reservoir bathymetry, and geology for Priest Rapids Dam are available from Grant County PUD. (See Photos 1 through 6.)

7. Current access to the right side of the dam is across Priest Rapids Dam only. The clear width and 90 degree turns across the spillway deck could restrict use of large construction equipment and an easement may be required to allow O&M personnel to access the new intake and pumping plant facilities.

8. The road over Priest Rapids Dam is the main access for the residents of the Wanapum Indian Village located downstream of the dam on the right side of the river. Leon stated that the Wanapum have jurisdiction over the land proposed for the intake, screening, and pumping

facilities and they should be consulted regarding construction of these features. Above ground features downstream of the dam may cause concern to the Wanapum Band of the Yakama Nation and those enrolled members of the Yakama Nation.

9. The dam was constructed between 1956 and 1961. Tapping the reservoir for water would translate into lost power revenue for Grant County PUD and they would be looking for compensation for this lost power revenue.

10. If the intake location was moved to the left side of the dam, the intake could use the existing overflow weir gravity intake structure to access the reservoir. The pumping plant could be located on the left side of the river upstream from the existing power plant switchyard, however, the discharge line would need to cross the river to get back on the correct alignment.

11. Ice flows and expanding ice sheets have not been a problem at the dam.

12. There are transmission lines on the left side of the river that can be tapped for power to the new facilities.

13. The dam historically does not spill often. Leon indicated that in order to meet Hanford Reach target flow requirements, we should plan on pumping low volumes over long periods of time.

14. The river below the dam at the proposed intake sites for WIS Schemes 3 and 4 is wide and shallow and these locations appear to be less favorable compared to an inlet within the reservoir. (See Photo 7.)

Black Rock Reservoir Site

1. The proposed reservoir will inundate Black Rock Valley, a grassy valley with a few residences that will need to be relocated. State Highway 24 is a 2-lane asphalt road with heavy truck traffic that runs through the middle of the valley. There are also phone and power poles on both sides of the valley that will need to be relocated. Mark DeLeon stated that there is also a pioneer cemetery in the valley that may require relocation. (See Photos 8 through 13.)

2. The saddle dam/spillway on the south side of reservoir will require placement of about 20 feet of fill on top of an existing high topography feature to bring it up to elevation 1815 feet. (See Photo 14.) Rock appears to be near the surface of this feature.

3. The WIS proposed spillway discharge channel to Dry Creek will need to be improved and may require modification of a timber bridge on State Highway 241 in order to pass any significant flow. This bridge, 241-17, currently has 6 feet of clearance between beams and channel bottom. (See Photos 15 and 16.)

4. If maximum reservoir water surface is at or above elevation 1800 feet, a saddle dike will be necessary on the west end of the reservoir. (See Photo 17.) The land is relatively flat on the west side of the reservoir and small fluctuations in reservoir elevation will result in large movement of the shoreline.

5. The outlet structure to the Roza Canal should be closer to the dam to reduce the amount of dead reservoir storage volume.

6. Reservoir seepage is a concern. The Ringold Formation and an overlying mantel of loess blankets much of the reservoir basin and are both believed to have relatively low permeability. Within the reservoir basin, these formations should not be disturbed if practicable during construction except as required for founding the dam. Additional investigation of the permeability of the reservoir foundation materials is needed.

Roza Canal

1. The powerplant/outlet structure facility at the Roza Canal should be located on the southwest corner of the Roza Canal and State Highway 24 intersection. (See Photos 18, 19, and 20.)

2. If a powerplant is constructed at Roza Canal, a bypass structure should be included to permit water deliveries when the units are not on line. (See Photo 21.)

ACTION ITEMS:

1. Norbert Ries will obtain a copy of the WIS fish biologist report that recommends moving the intake to the left side of Priest Rapids Dam.

2. Norbert Ries will investigate Tribal land ownership near Priest Rapids Dam.

Photo 1 - Priest Rapids Dam - Looking upstream along right embankment section.

Photo 2 - Priest Rapids Dam - Looking upstream along right embankment section.
Note docking facility in background.

Photo 3 - Priest Rapids Dam - Looking upstream along right embankment section. Proposed canal and fishscreens would be located between embankment and ridge.

Photo 4 - Priest Rapids Dam - Looking upstream along proposed intake canal alignment.

Photo 5 - Priest Rapids Dam - Looking at proposed pumping plant site.

Photo 6 - Priest Rapids Dam - Looking downstream along proposed intake canal.

Photo 7 - Columbia River - Looking at WIS Scheme 4 Intake site.

Photo 8 - Black Rock Reservoir - Looking toward left abutment of WIS original dam alignment.

Photo 9 - Black Rock Reservoir - Looking at right abutment of WIS original dam alignment.

Photo 10 - Black Rock Reservoir - Looking upstream from proposed damsite along south reservoir rim.

Photo 11 - Black Rock Reservoir - Looking upstream from proposed damsite.

Photo 12 - Black Rock Reservoir - Looking upstream from proposed damsite at State Highway 24.

Photo 13 - Black Rock Reservoir - Looking upstream from proposed damsite.

Photo 14 - Black Rock Reservoir - View of saddle dam area on south side of reservoir.

Photo 15 - Black Rock Reservoir - WIS proposed spillway channel near State Highway 241.

Photo 16 - Black Rock Reservoir - WIS proposed spillway channel under State Highway 241.

Photo 17 - Black Rock Reservoir - View of possible saddle dike area at west end of reservoir across State Highway 24.

Photo 18 - Roza Canal - Looking at southwest corner of State Highway 24 and Roza Canal intersection at proposed powerplant/outlet structure facility.

Photo 19 - Roza Canal near State Highway 24 - Looking upstream.

Photo 20 - Roza Canal near State Highway 24 - Looking downstream.

Photo 21 - Roza Canal - Looking at possible powerplant site at Sunnyside Delivery point.

Attachment 3

Black Rock Storage Project

Site Review Closeout Meeting
October 30, 2003

PARTICIPANTS:

NAME	COMPANY
Dick Link	Pacific Northwest Region Office
Don Stelma	Pacific Northwest Region Office
Steve Montague	Pacific Northwest Region Office
John Kirk	State of Washington - Department of Ecology
David Cummings	State of Washington - Department of Ecology
Tom Ring	Yakama Nation - Water Resources
Norbert Ries	Upper Columbia Area Office
Bernie Meskimen	Pacific Northwest Construction Office
Wendy Christensen	Pacific Northwest Construction Office
Charles Ferguson	Pacific Northwest Construction Office
John Manfredi	Pacific Northwest Construction Office
Doug Stanton	Technical Service Center
Dave Edwards	Technical Service Center
Bill Engemoen	Technical Service Center
Pete Rohrer	Technical Service Center
Dick LaFond	Technical Service Center

MAJOR DISCUSSION TOPICS: The following items were discussed:

General:

Land acquisition and right-of-way costs are not included in the WIS Report (p. 9-2) but should be included in future studies to better estimate project costs.

Intake at Priest Rapids Dam:

1. The intake on the right side of the dam looks best. Placing the intake on the left side would be difficult and expensive to pipe water across the river.

2. Initial preference is to locate intake near the docking facility on the right side of the reservoir, which would entail a penetration of the embankment. The water would then be conveyed about 1,000 feet in a canal paralleling the hills. The canal would create sweeping velocities and thus allow for placement of diagonal fish screens within the canal. One or more bypasses would be provided to pass the screened fish downstream (perhaps along the downstream embankment toe) to the Columbia River below the dam.

3. A cofferdam will be required in the reservoir to permit construction of the intake. Also, construction access across the dam will be difficult. Consideration should be given to developing an access road through the Yakima Firing Center Military Reservation property on the right side.

4. Priest Rapids operating personnel expressed that obtaining Tribal permission to construct any surface features on the right side of the dam could be controversial.

5. The TSC should consider a low profile pumping plant similar to the existing Columbia River Plant located downstream from Priest Rapids Dam. It may be possible, although expensive, to construct an underground plant in an exposed rock face if above ground features are restricted.

Inflow Options to Black Rock Reservoir:

1. Washington's Scheme 1A featuring a tunnel through the Umtanum and Yakima Ridges to Black Rock Reservoir appears feasible, however, the pumped-storage scheme (1B) does not appear to be economically feasible at this time. Although expensive, Scheme 1A would result in significant savings in annual pumping costs.

2. To reduce costs of the inflow system, D-8140 will develop a tunnel/pipeline option based on the preferred intake location downstream of the Grant PUD docking facility.

3. It may be worth looking at an all pipeline alternative (similar to Scheme 3) as well in the fast track study although a river intake may be problematic.

4. Construction of a powerplant on the end of the intake system at Black Rock Reservoir will depend on available head at the outlet and anticipated operation of the intake system.

5. Monthly maximum and minimum projected flows are required to properly size facilities.

Black Rock Damsite:

1. At this point, it appears premature to rule out any one of the three considered dam types: concrete faced rockfill, central core rockfill, and roller compacted concrete (RCC). Cost estimates may need to be developed for all three dam types.

2. Both the original WIS alignment and the newer upstream alignment appear feasible. No other preferred alignment was apparent from the site visit.

3. There appear to be advantages to each alignment. The WIS axis has the shortest dam length, apparently by several hundred feet. With such a high dam, this probably results in a savings of several million cubic yards of embankment or RCC materials. The upstream axis, however, **may** have less overburden, which would result in significant excavation (and replacement) and dewatering cost savings. In addition, the rock quality **may** be better, which could lead to lower foundation treatment costs.

4. It is likely that the preliminary seismic hazard assessment will not be able to rule out the potential for fault displacements within the dam footprints. This issue will need to be considered in more detail in higher level designs, when more definitive predictions of movement will hopefully be available. This may have a significant impact on selection of dam type.

5. Efforts are currently underway in the Pacific Northwest Region Office to better evaluate the water supply availability and thus the resulting optimum reservoir size. A reservoir size will be needed before significant work on the designs and costs can be started.

6. Both the damsite and reservoir geology are quite complex, given the presence of the folding and faulting, highly variable rock quality, multiple aquifers, and questions on the depth and character of overburden deposits. The additional work to be undertaken in the next couple of months to better characterize the geology should help the design effort.

7. The above additional geologic work will concentrate on better defining the bedrock stratigraphy and properties, and the overburden (particularly the Ringold) properties as well.

8. Because the depth to bedrock will be quite important to design costs and possibly dam type, Dick Link will look into the possibility of fast-tracking a contract for a geophysical survey of the damsite in order to determine the depth to bedrock.

9. In addition to investigating foundation conditions, evaluating the availability of construction materials is equally important. Identifying potential sources and resulting haul distances for rockfill, impervious fill, granular filter/drain materials, and RCC aggregate would allow for better estimates of the costs of building the dam.

10. There was much discussion about the reservoir-holding capability. The Region will be conducting an evaluation of the hydrogeology of the foundation, which should help address this issue and perhaps shed light on the foundation grouting requirements. There was little indication that any interflow zones outcropped in the reservoir area. It was also noted, that the horizontal permeability of the interflow zones within the basalt flows is orders of magnitude higher than the vertical permeability. In addition, there are indications that the Ringold (and probably other overburden units like the loess) have lower permeability than the basalts. All of these factors are viewed as very positive aspects to reducing the potential for reservoir seepage.

Spillway/Saddle Dam Area:

1. Although it will depend on the size of the reservoir, it appears likely that some type of embankment will be needed in the low saddle area in the south reservoir rim. It also appears that rock will be close to the surface, which should allow for a relatively economical embankment.

2. The TSC will address the need for an emergency spillway. Given the large area of the reservoir and the fact that it is offstream storage, it may be possible to store the design flood. The TSC will look into the hydrology and evaluate if the PMF can be stored in the reservoir.

Low Level Outlet Works:

1. This is essentially a dam safety feature, that will evacuate the reservoir in the event of an emergency, spilling flows into the normally dry Dry Creek.

2. The sizing of the outlet works by WIS is somewhat unclear. During the Assessment Study, the TSC will size the low level outlet works to meet Reclamation evacuation criteria.

3. An option to consider in lieu of a low level outlet to Dry Creek might be to pump water back to the Columbia River. Given that an outlet works would release water into either the Columbia or Yakima Rivers, the impacts to existing fisheries would need to be addressed considering the likelihood of this ever occurring.

Outlet Tower and Outflow Schemes:

1. WIS designed a multi-level intake to discharge water into the outflow conduit to the Roza Canal. The team questions why a multi-level intake would be necessary if the water will be used for irrigation purposes only and there are no downstream fish considerations.

2. Fish screens will be required on the outlet structure to prevent fish that may be stocked in the reservoir from migrating to the Yakima Basin.

3. WIS Outflow Scheme 1, which requires a pumping plant to lift water from Black Rock Reservoir to the Roza Canal is not being developed at this time. The team would prefer to locate the outlet system to permit gravity flow to Roza Canal.

4. WIS Outflow Scheme 3 is eliminated because it delivers water too far below where it is needed.

5. For the Black Rock Project Assessment, water deliveries to the Roza and Sunnyside Divisions will be used to size features. The design maximum flow to the Roza Division will be 1,100 ft^3/s, and the design maximum flow to the Sunnyside Division will be 1,262 ft^3/s, for a total capacity of 2,362 ft^3/s. Water deliveries to Union Gap and or Selah-Moxee could be added in the future if they express an interest which would increase required capacity by 100 to 150 ft^3/s. Monthly maximum and minimum projected flows are required to properly size facilities.

Highway Realignment

1. The WIS Final Report relocated State Highway 24 to the south of the reservoir in the Rattlesnake Hills but indicated that residents of Black Rock Valley would prefer a northern relocation. Topography on the north side of the reservoir is not conducive for this road relocation because many bridges would be required to span over draws and the road would need to be constructed on land currently within the Yakima Firing Center Military Reservation.

2. Ongoing geologic mapping in the vicinity of the alternate alignment suggests a potential for significant landslides along the south rim of the reservoir due to oversteepening of bedrock foundation units. Development of highway relocation concepts should account for a high potential for landsliding along the south reservoir rim.

Roza and Sunnyside Distribution Systems

From the perspective of service areas and major conveyance facilities, the Roza and Sunnyside Divisions appear to be located so that a Columbia River water exchange may be feasible. Following discussions with these two irrigation divisions concerning their willingness to consider water exchanges, work was initiated early September 2003 by engineering staff of the PN Construction Office and the Regional Office to develop conceptual plans and cost estimates for the delivery of Columbia River water.

1. The powerplant/outlet structure facility at the Roza Canal should be located on the southeast corner of the Roza Canal and State Highway 24 intersection. The available head at the Roza canal will be reservoir dependent. Provisions for bypassing units should be provided to permit water deliveries when the units are not on line.

2. At the beginning of each irrigation season, the Roza and Sunnyside Irrigation Districts flush their canals and dump water into the Yakima River. This operating procedure may need to be modified to prevent discharging Columbia River water directly into the Yakima River.

3. Steve Montague has developed two options for supplying the Sunnyside Irrigation District.

a. Option A - Pipeline - A pipeline with 1,262 ft^3/s capacity would bifurcate off the outflow pipe directly upstream of the new Roza Canal Powerplant. The new pipeline would generally parallel the Roza Canal alignment across orchards to the top of Konnowock Pass, then generally parallel Konnowock Pass Road across open land and orchards until it ties into Sunnyside Canal at approximate mile 3.85. At the Sunnyside Canal, a powerplant would be constructed to burn the excess of approximately 400 feet of head. An 18-inch diameter pipe would bifurcate upstream of this powerplant to supply approximately 15 ft^3/s to upstream water users. The initial head required for this pipe will be approximately 185 feet (80 psi).

b. Option B - Canal - For this option, Sunnyside and Roza (south) flows would be combined in an enlarged Roza Canal. The enlarged canal would have a total capacity of 2,562 ft^3/s which is equal to the existing canal capacity of 1,300 ft^3/s plus an additional 1,262 ft^3/s for

Sunnyside water users. This option will require an enlargement of an existing tunnel or construction of a new tunnel adjacent to the existing. At Wasteway No. 3, Sunnyside water would be discharged into an enlarged wasteway. The capacity of the modified wasteway will be 2,514 ft^3/s (1,252 ft^3/s for the existing wasteway capacity plus 1,262 ft^3/s for Sunnyside water users). A series of check/drop structures will be required in the wasteway to decrease the hydraulic slope and velocities. At approximately wasteway station 95+00, the Sunnyside flow will be diverted to a pipe for delivery to a powerplant constructed to use the approximately 180 feet of head at Sunnyside Canal mile 3.85. An 18-inch diameter pipe would bifurcate upstream of this powerplant to supply approximately 15 ft^3/s to upstream water users.

4. Wendy Christensen is sizing delivery facilities to the Roza Irrigation District. At the proposed canal tie-in at State Highway 24, 215 ft^3/s is required to be delivered upstream (north), and 885 ft^3/s is required to be delivered downstream (south). The elevation of the Roza Canal near State Highway 24, is about 1,170 feet. Wendy estimates that she needs about 330 feet of head to make the upstream deliveries. This could be accomplished by one of two ways:

Option 1A - Bifurcate a pipeline with 215 ft^3/s capacity off the outflow pipe directly upstream of the new Roza Canal Powerplant. An energy dissipator would be required at the end of this pipe and pressure reducing valves would be required for deliveries.

Option 1B – Run all Roza water (1,100 ft^3/s) through a powerplant at the canal and supply pumps, manifold, and discharge pipe to lift 215 ft^3/s to north-side Roza water users. John Manfredi stated that if this option is selected, the Yakima Construction Office would prefer to use variable frequency drive pumping units to accommodate variations in water demand.

ACTION ITEMS:

Wendy Christensen (Roza) and Steve Montague (Sunnyside) will continue to work on irrigation delivery systems from where State Highway 24 crosses the Roza Canal to the termination of the irrigation. The TSC will assist them with tunnel design input, transient studies, powerplant, pumping plant, and air chamber sizing and quantities.